

IN THE CLAIMS

1. (Currently Amended) A method of metallizing a substrate, comprising:
depositing a dual-purpose layer on the substrate wherein a first purpose is to serve as a barrier layer and a second purpose is to serve as a seed layer;
electrochemically reducing oxides on the surface of the dual-purpose layer using a first electrolyte where the first electrolyte includes is the a cation species of material of the an anode in an electrochemical reaction cell; and
electrochemically depositing a conductive interconnect layer on the surface of the dual-purpose layer using a second electrolyte, wherein the conductive interconnect layer includes conductive material other than the cation species in the first electrolyte used to electrochemically reduce the oxides.
2. (Original) The method of claim 1, wherein the dual-purpose layer comprises a material capable of reducing diffusion of the conductive interconnect material into surrounding materials, and wherein the dual-purpose layer comprises a material having a resistivity that allows electrochemical deposition of the conductive interconnect material.
3. (Original) The method of claim 1, wherein the dual-purpose layer comprises a material selected from the group consisting of tungsten, tungsten nitride, and tungsten-silicon nitride.
4. (Original) The method of claim 1, wherein the material comprising the dual-purpose layer comprises tungsten.
5. (Original) The method of claim 1, wherein the conductive interconnect material comprises copper.
6. (Original) The method of claim 1, wherein a voltage of at least about 0.1 V and not more than about 1 V is applied during both the electrochemically reducing step and the electrochemically depositing step for a time period of from about 30 seconds to about 5 minutes.

7. (Original) The method of claim 1, wherein a current of from about 0.5 amps to about 10 amps and having a current density of from about 5 mA/cm² to about 25 mA/cm² is applied during both the electrochemically reducing step and the electrochemically depositing step.
8. (Original) The method of claim 1, wherein a current of from about 0.5 amps to about 10 amps and having a current density of from about 10 mA/cm² to about 15 mA/cm² is applied during both the electrochemically reducing step and the electrochemically depositing step.
9. (Original) The method of claim 1, wherein a current of from about 0.5 amps to about 10 amps and having a current density of about 12 mA/cm² is applied during both the electrochemically reducing step and the electrochemically depositing step.
10. (Canceled)
11. (Previously Presented) The method of claim 12, wherein the anode is formed from titanium or titanized platinum.
12. (Currently Amended) A method of metallizing a substrate, comprising:
 - depositing a dual-purpose layer on the substrate wherein a first purpose is to serve as a barrier layer and a second purpose is to serve as a seed layer;
 - electrochemically reducing oxides on the surface of the dual-purpose layer in an electrochemical reaction cell comprising an anode formed from a material that can be oxidized in the presence of the material comprising the dual-purpose layer;
 - electrochemically depositing a conductive interconnect layer on the surface of the dual-purpose layer; and
 - wherein the electrochemical reaction cell contains a first electrolyte comprising the cation of the material used to form the anode, and the conductive interconnect layer includes conductive material other than the cation species in the first electrolyte used to electrochemically reduce the oxides.

13. (Previously Presented) The method of claim 12, wherein the anode comprises titanium and the first electrolyte comprises titanium trichloride, titanium sulfate, titanium bromide, titanium trichloride, titanium iodide, titanium fluoride, or mixtures thereof.
14. (Original) The method of claim 13, wherein the first electrolyte comprises titanium trichloride or titanium sulfate.
15. (Canceled)
16. (Previously Presented) The method of claim 25, wherein the electrochemically reducing step is performed in a first electrochemical reaction cell and the electrochemically depositing step is performed in a second electrochemical reaction cell.
17. (Previously Presented) The method of claim 25, wherein the electrochemically reducing step and the electrochemically depositing step are performed in a single electrochemical reaction cell.
18. (Previously Presented) The method of claim 25, wherein the electrochemical reducing step is performed using a first anode and the electrochemical depositing step is performed using a second anode.
19. (Previously Presented) The method of claim 25, wherein the electrochemical reducing step and the electrochemical depositing step are performed using a single anode.
20. (Previously Presented) The method of claim 25, wherein the dual-purpose layer comprises a material selected from the group consisting of tungsten, tungsten nitride, and tungsten-silicon nitride.
21. (Previously Presented) The method of claim 25, wherein the material comprising the dual-purpose layer comprises tungsten.

22. (Previously Presented) The method of claim 25, wherein the conductive interconnect material comprises copper.

23. (Previously Presented) The method of claim 25, wherein the first anode comprises a material that can be oxidized in the presence of the material comprising the dual-purpose layer.

24. (Previously Presented) The method of claim 25, wherein the first anode is formed from titanium or titanized platinum, platinum, or copper.

25. (Currently Amended) A method of metallizing a substrate, comprising:
depositing a dual-purpose layer on the substrate wherein the dual-purpose layer serves as a barrier layer and a seed layer;
electrochemically reducing oxides on the surface of the dual-purpose layer utilizing a first electrolyte in an electrochemical bath having an anode and a cathode;
electrochemically depositing a conductive interconnect layer on the surface of the dual-purpose layer utilizing a second electrolyte; and
wherein the first electrolyte contains the cationic species of the material comprising the first anode, and the conductive interconnect layer includes conductive material other than the cation species in the first electrolyte used to electrochemically reduce the oxides.

26. (Previously Presented) A method of metallizing a substrate, comprising:
depositing a dual-purpose layer on the substrate wherein the dual-purpose layer serves as a barrier layer and a seed layer;
electrochemically reducing oxides on the surface of the dual-purpose layer utilizing a first electrolyte;
electrochemically depositing a conductive interconnect layer on the surface of the dual-purpose layer utilizing a second electrolyte; and
wherein the first electrolyte comprises titanium sulfate, titanium bromide, titanium trichloride, titanium iodide, titanium fluoride, copper sulfate, or mixtures thereof.

27. (Previously Presented) A method of metallizing a substrate, comprising:
depositing a dual-purpose layer on the substrate wherein the dual-purpose layer serves as a barrier layer and a seed layer;
electrochemically reducing oxides on the surface of the dual-purpose layer utilizing a first electrolyte in an electrochemical cell having an anode;
electrochemically depositing a conductive interconnect layer on the surface of the dual-purpose layer utilizing a second electrolyte; and
wherein the first anode is formed from titanium and the first electrolyte is titanium chloride or titanium sulfate.
28. (Previously Presented) The method of claim 25, wherein a voltage of at least about 0.1 V and not more than about 1 V is applied during both the electrochemically reducing step and the electrochemically depositing step for a time period of from about 30 seconds to about 5 minutes.
29. (Previously Presented) The method of claim 25, wherein a current of from about 0.5 amps to about 10 amps and having a current density of from about 5 mA/cm² to about 25 mA/cm² is applied during both the electrochemically reducing step and the electrochemically depositing step.
30. (Previously Presented) The method of claim 25, wherein a current of from about 0.5 amps to about 10 amps and having a current density of from about 10 mA/cm² to about 15 mA/cm² is applied during both the electrochemically reducing step and the electrochemically depositing step.
31. (Previously Presented) The method of claim 25, wherein a current of from about 0.5 amps to about 10 amps and having a current density of about 12 mA/cm² is applied during both electrochemically reducing step and the electrochemically depositing step.

32. (Currently Amended) A method of metallizing a substrate, comprising:
depositing a dual-purpose layer on the substrate wherein the dual-purpose layer serves as a barrier layer and a seed layer;
electrochemically reducing oxides on the surface of the dual-purpose layer utilizing a first electrolyte;
electrochemically depositing a conductive interconnect layer on the surface of the dual-purpose layer utilizing a second electrolyte, the conductive interconnect layer including conductive material other than a cation species in the first electrolyte used to electrochemically reduce the oxides ; and
wherein the ~~first~~ second electrolyte comprises:
the cation of the material from which the conductive interconnect layer is made;
a complexing agent; and
a pH control agent.
33. (Original) The method of claim 32, wherein the conductive interconnect layer comprises copper and the electrolyte comprises copper sulfate.
34. (Original) The method of claim 32, wherein the complexing agent is selected from the group consisting of ethylene diamine tetra acetate, boric acid, and malonic acid.
35. (Original) The method of claim 32, wherein the complexing agent is ethylene diamine tetra acetate.
36. (Original) The method of claim 32, wherein the pH control agent is tetramethyl ammonium hydroxide, ammonium hydroxide, or potassium hydroxide.
37. (Original) The method of claim 32, wherein the pH control agent is tetramethyl ammonium hydroxide.

38. (Original) The method of claim 32, wherein the electrolyte exhibits a pH greater than about 7.

39. (Original) The method of claim 32, wherein the electrolyte exhibits a pH greater than or equal to about 10.

40. (Original) The method of claim 32, wherein the electrolyte exhibits a pH greater than about 7 and less than or equal to about 12.

41. (Original) The method of claim 32, wherein the electrolyte exhibits a pH greater than about 10 and less than or equal to about 12.

42. (Canceled)

43. (Previously Presented) The method of claim 44, wherein the dual-purpose layer comprises tungsten.

44. (Currently Amended) A method of metallizing a substrate, comprising:
depositing a dual-purpose layer on the substrate wherein the dual-purpose layer serves as a barrier layer and a seed layer;
electrochemically reducing oxides on the surface of the dual-purpose layer;
electrochemically depositing a conductive interconnect layer on the surface of the dual-purpose layer, wherein both the electrochemically reducing step and the electrochemically depositing step are performed in a single electrochemical reaction cell utilizing a single electrolyte;
wherein the electrolyte comprises:
the cation of the material from which the conductive interconnect material is made;
a complexing agent; and
a pH control agent; and

injecting a second electrolyte into the single electrochemical reaction cell after electrochemically depositing the conductive interconnect layer to an initial thickness to deposit additional material to thicken the layer of conductive interconnect layer to a selected thickness.

45. (Previously Presented) A method of metallizing a substrate, comprising:
depositing a dual-purpose layer on the substrate wherein the dual-purpose layer serves as a barrier layer and a seed layer;
electrochemically reducing oxides on the surface of the dual-purpose layer;
electrochemically depositing a conductive interconnect layer on the surface of the dual-purpose layer, wherein both the electrochemically reducing step and the electrochemically depositing step are performed in a single electrochemical reaction cell utilizing a single electrolyte;
wherein the electrolyte comprises:
the cation of the material from which the conductive interconnect material is made;
a complexing agent; and
a pH control agent; and
wherein the conductive interconnect material comprises copper and the electrolyte comprises copper sulfate.

46. (Original) The method of claim 44, wherein the complexing agent is selected from the group consisting of ethylene diamine tetra acetate, boric acid, and malonic acid.

47. (Previously Presented) A method of metallizing a substrate, comprising:
depositing a dual-purpose layer on the substrate wherein the dual-purpose layer serves as a barrier layer and a seed layer;
electrochemically reducing oxides on the surface of the dual-purpose layer;
electrochemically depositing a conductive interconnect layer on the surface of the dual-purpose layer, wherein both the electrochemically reducing step and the electrochemically depositing step are performed in a single electrochemical reaction cell utilizing a single electrolyte;

wherein the electrolyte comprises:

the cation of the material from which the conductive interconnect material is made;

a complexing agent; and

a pH control agent; and

wherein the complexing agent is ethylene diamine tetra acetate.

48. (Original) The method of claim 44, wherein the pH control agent is tetramethyl ammonium hydroxide, ammonium hydroxide, or potassium hydroxide.

49. (Original) The method of claim 44, wherein the pH control agent is tetramethyl ammonium hydroxide.

50. (Original) The method of claim 44, wherein the electrolyte exhibits a pH greater than about 7.

51. (Original) The method of claim 44, wherein the electrolyte exhibits a pH greater than or equal to about 10.

52. (Original) The method of claim 44, wherein the electrolyte exhibits a pH greater than about 7 and less than or equal to about 12.

53. (Original) The method of claim 44, wherein the electrolyte exhibits a pH greater than about 10 and less than or equal to about 12.

54. (Previously Presented) The method of claim 44, wherein a voltage of at least about 0.1 V and not more than about 1 V is applied during both the electrochemically reducing step and the electrochemically depositing step for a time period of from about 30 seconds to about 5 minutes.

55. (Previously Presented) The method of claim 44, wherein a current of from about 0.5 amps to about 10 amps and having a current density of from about 5 mA/cm² to about 25

mA/cm² is applied during both the electrochemically reducing step and the electrochemically depositing step.

56. (Previously Presented) The method of claim 44, wherein a current of from about 0.5 amps to about 10 amps and having a current density of from about 10 mA/cm² to about 15 mA/cm² is applied during both the electrochemically reducing step and the electrochemically depositing step.

57. (Previously Presented) The method of claim 44, wherein a current of from about 0.5 amps to about 10 amps and having a current density of about 12 mA/cm² is applied during both the electrochemically reducing step and the electrochemically depositing step.

58.–94. (Canceled)